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| Name: Dr. Leslie Suters Date: *written Fall 2014*  Lesson Title: Electrical Circuits  Grade Level: 4th  Length of Lesson (Minutes): 70 |
| **Common Core State Standards or State Standards**  (*Include the number and the entire standard. Highlight relevant portion emphasized in this lesson*.) |
| **Embedded Inquiry**  GLE 0407.Inq.1 Explore different scientific phenomena by asking questions, making logical predictions, planning investigations, and recording data.  Check for Understanding 0407.Inq.3 Maintain a science notebook that includes observations, data, diagrams, and explanations.  **Standard 12: Forces in Nature** GLE 0407.12.3 Explain how electricity in a simple circuit requires a complete loop through which current can pass. Check for Understanding 0407.12.3 Describe how electricity passes through a simple circuit that includes a battery, wire, switch, and bulb.SPI 0407.12.3 Determine the path of an electrical current in a simple circuit. |
| **Central Focus of Unit/Learning Segment**  (*The single instructional theme or essential question across the planned learning segment that is aligned with content standards and relevant learning objectives*.) |
| *Essential Question*: What are 2 different ways that can be used to create a circuit?  *Central Focus*: Series and Parallel Circuits |
| **Lesson Objectives**  (*Observable statements that specify what students will be able to do at the conclusion of a lesson. Such objectives should be aligned with relevant content standards and should include verbs that allow for measurement of students’ achievement of the desired outcome*.) |
| The learner will:   * perform an experiment using guided inquiry to determine how electricity flows through a circuit in 2 ways: series & parallel. * explain how electricity in a simple circuit requires a complete loop through which current can pass. * use the science practices of making predictions & stating observations as they compare and contrast circuit types in their foldable, notebook, and 3-2-1 assessment. |
| **Language Demands** |
| **Language Function & Key Learning Task**  (*Identify a language function central to the learning segment and a key learning task that provides students with the opportunity to practice using it. A language function is the purpose for using language in the learning task or what students will use the language to do; it’s typically represented by an action verb in the lesson objective. Examples include, but are not limited to: analyze, argue, categorize, compare/contrast, describe, explain, interpret, justify, model, predict, question, retell, summarize*…)  *Language Function*: Explain; Compare/Contrast  *Key Learning Task*: Students will construct a foldable to define, sketch, and label series and parallel circuits as well as the tools used for experimentation with circuits.  **Content/Academic Vocabulary**  (*List and define the content vocabulary taught in the lesson*.)  Types of Circuits  Circuit- a roughly circular line, route, or movement that starts and finishes at the same place. Closed Circuit: Connection between the sources of electricity and the appliance or device is continuous; turned on Open Circuit: a break or gap in the circuit; the flow of electricity stops Series Circuit: a type of circuit in which all energy travels through every device in one loop. If any part of the circuit is disconnected the flow of energy stops. Parallel Circuit: a type of electrical circuit in which there are two or more paths for the energy to travel to. If any branch is disconnected the energy will still travel to the other branches.  Tools Used to make Electrical Circuits   1. Switches: safe and convenient way to open or close circuits 2. Batteries: called dry cells; D-size or #6 are safest - deliver 1 1/2 volts of electricity; source of electric power in an electric circuit 3. Bulbs: a glass bulb inserted into a lamp or a socket, which provides light by passing an electric current through a filament or a pocket of inert gas. (Match the bulb with the # of 1 1/2-volt cells used; Commonly you will use bulbs labeled as one-cell or 1.2V and two-cell or 2.5V) 4. Fahnestock (Wire) Clips: Used to make connections to sockets and wires 5. Wires can be connected in series (one loop, such as outdated Christmas Tree lights) or parallel (2 or more loops, such as wiring in houses) 6. Load**:** the part of the circuit operated by the electricity, such as a light bulb or a motor.   **Discourse & Syntax**  (*Describe how students will use one or both of the following. Include language that you will expect students to use verbally and in written form*.)  Discourse (*how students talk and verbally communicate in knowledge construction in ways specific to discipline*)  The students will plan and carry out an investigation to discover circuit types, they will be using scientific discourse practices of making predictions & observations as they compare and contrast circuit types in their foldable, notebook, and 3-2-1 assessment. They will need to decide the number of wires they need, what type of load to use (bulb, motor or combination), the number of batteries as well as how to combine them all to make a closed circuit in two different ways. They will not be told the scientific terms or definitions prior to exploration with the tools; therefore, they will need to use their own invented vocabulary to describe what they are observing just as scientists would in their investigations. As students describe what they observe and discover, the teacher will provide formal terms for the students to write in their foldables and interactive notebooks as labels. They will use these terms as they extend their learning to discover how to make the bulbs burn brighter or the motors turn faster.  Syntax (*set of written conventions specific to discipline for organizing symbols, words, & phrases together into structures, for example, sentences, formulas, staffs in music, etc*.)  The students will make annotated sketches of their circuits and need to clearly label different parts. Sample Image for series and parallel circuits that students could sketch in their notebooks and label.  Source: <http://electricityelectrifiesmylife.blogspot.com/2013/03/series-and-parallel-circuits.html>    **Supports**  (*What opportunities AND supports will you provide for students to use the language function, practice and apply content language/academic vocabulary, and integrate discourse and syntax? Describe how you & students will use these supports. (i.e., graphic organizer, anchor chart, foldable, chart, model, word wall, and strategies such as think, pair, share, etc.). Consider how you will use/differentiate these supports to meet the needs of learners with different levels of language learning*.)  The students will be using an interactive notebook to record their predictions and observations with different types of circuits and they will create a foldable to write the formal definitions and include sketches. The teacher will circulate and observe students as they are conducting their investigations. As different groups of students begin to discover techniques for completing the circuits she will ask these groups to model their strategies for other groups of students that have not been able to complete the task. They will be asked to share their sketches and labels and explain what they observed to the other students. During the “Explain” section of the plan, select student groups will refer to their interactive notebooks and share their work with the rest of the class using the document camera as they explain their observations. The teacher will provide formal terms for series and parallel circuits for students to write in foldables at this time. |
| **Materials/Resources**  (*What do you need for this lesson*?) |
| Engage  1 Energy Ball per group of 3  *Per student: copy of*  *Batteries, Wires, and Bulbs* Formative Assessment Probe  Explore, Explain, Extend  *Per group of 3*:  batteries (4-5), Wire clips-3, sockets-2, light bulbs -2, motors-2, switches-2  *Per person*: Scissors & paper for making foldable, Interactive Science Notebook |

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| **Assessment/Evaluation Criteria** |

**Formative Assessment**

(*A range of assessment procedures used by teachers during the learning process in order to modify teaching and learning activities to improve student achievement occurring throughout the lesson*.)

Assessment tools:

1. Pre-assessment – formative assessment probe (attached to plan)
2. Graphic Organizer Foldable
3. Interactive Science Notebook
4. Teacher checklist for group work

I will be using a formative assessment probe at the beginning of the lesson called Batteries, Bulbs, and Wires. This elicits student understanding of how many wire strips it takes to connect a battery to a bulb so that the bulb will light. (the answer is one.) They include a written explanation and a sketch, which will share their prior knowledge about constructing a simple circuit.

As students perform their experiments to discover circuit types, they will be making predictions & observations as they compare and contrast circuit types in their foldable, and notebook. I will use a checklist as I observe student groups to track groups of students who construct series and parallel circuits.

**Summative Assessment**

(*Summative assessments occur at the end of the lesson to determine what students know and do not know. What evidence will you collect and how will it document individual student learning/mastery of lesson objectives? Include evaluation criteria such as a checklist, rubric, answer key, % earned for mastery, etc. Attach copies of any documents that will be used as evidence*.)

Assessment Tool: 3-2-1 Assessment (attached to plan)

This assessment is organized into 3 parts.

**Part one** - asks students to respond to 3 multiple-choice questions.

Question 1 assesses Objective 2 – …how electricity in a simple circuit requires a complete loop.

Question 2 & 3 assesses Objectives 1 - … how electricity flows through a circuit in series & parallel.

*Mastery =* 3/3 questions answered correctly

**Part two** - asks students to describe the 2 types of circuits constructed in class and include sketches. This assesses Objective 1, 2, & 3.

*Mastery =* drawing and labeling a complete circuit for both series (shows one loop) and parallel (shows at least 2 loops) circuits and sketching the battery, bulbs/motors, and wires.

**Part three** – asks students to think of an additional topic of inquiry that they’d like to explore regarding circuits.

**Academic Feedback**(*Based on your formative and summative assessments, How will you monitor and/or give academic feedback? How will students use the academic feedback? What opportunities are you giving students to use academic feedback*?)

I will make close observations as students work in small groups during the lesson. I will be looking at the circuits they complete as well as the entries they make into their notebooks and foldables and use a checklist for documenting group construction of each type of circuit. I will provide guiding questions and assistance to groups and individuals within groups that are having difficulty constructing the circuits. Successful student groups will also have the opportunity to assist struggling groups as a means to constructively use academic language and help others become successful. I will write comments directly on their 3-2-1 assessment, graphic organizer foldable, & science notebook and return to the students next day. Students will use the feedback to write a claim about the difference between series and parallel circuits. They will need to use evidence from their interactive notebook, 3-2-1 assessment, and foldable to support their claim.

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| **Instruction**  (*Include a suggested time for each major activity in the plan below*.)  *Be sure to include both formative and summative assessment within your instructional plan. This plan should be highly detailed and carefully sequenced with information so that another teacher could implement your plan. The plan explains both student and teacher actions.* | **Higher-Order Thinking Questions**  *Identify high order thinking questions that cannot be answered with a yes or no*. |
| **Set/Hook/Motivator**  (*This brief section at the beginning of the lesson grabs the students’ attention and focuses their thoughts on the learning objectives by utilizing knowledge of students’ academic, social, and cultural characteristics*.)  **Engage**: Part I. Ask each group to find creative ways to activate the energy ball. Share findings with class. Ask class to join hands and activate one energy ball. Ask one person to let go – what happens to the energy ball (stops working). Discuss open and closed circuits. (5 min)  Part II. *Batteries, Wires, and Bulbs* Formative Assessment Probe (*FACT #14 Familiar Phenomenon Probes*). Display question on document camera and allow class to answer individually, pair to discuss, and then share with class. (FACT #61 Think-Pair-Share) Allow class to test their predictions briefly. (5 min) | **Application**: How can you individually make the energy ball activate? As a small group? As an entire class?  **Application**: How many wire strips does it take to connect a battery to a bulb so that the bulb will light? |
| **Instructional Procedures**  (*This is the body of the lesson plan; it is the way in which information is shared with students and the methods used to help them assume a level of mastery of that material*.)  Explore: (15 minutes)  Use a guided inquiry format to ask groups to find 2 different ways to light 2 bulbs or a bulb & a motor with the use of at least 3 wires and a switch. Students should record their work in their interactive science notebooks in the form of sketches with labels.  Explain: (15 minutes)  Students share their discoveries in finding different ways to light their bulb or start a motor.  At this time the teacher will share the terms for the 2 types of circuits that the students discovered. Series (one loop) and parallel (2 or more loops).  To record their findings the students will create a graphic organizer. Students should get a piece of colored paper and fold it in half, hot dog style, and then cut slits only on the top sheet of the paper so that they have three even flaps on the top. On flap one, students should write “series”, on flap two students should write “parallel”. Underneath each flap students should draw what they created, labeling each part of their drawings. The 3rd flap will be used to sketch and label the tools used. The teachers will model on the document camera for those students that need assistance.  Extend: (15 minutes) Ask students to extend their learning by exploring further with series & parallel circuits Student findings should be written in interactive notebooks. Use questions provided.  Transition: (5 minutes)  Circuit Builder  [http://www.bbc.co.uk/schools/podsmission/electricity/annie03.shtml#](http://www.bbc.co.uk/schools/podsmission/electricity/annie03.shtml)  Quickly respond to the 6 scenarios as a class – helps test their understanding of what makes a strong and weak circuit by telling whether they think the bulb will be bright or dim. | Explore – **Application**: What are 2 different ways that you can you make 2 bulbs light with at least 3 wires and a switch?  Explain – **Analysis**: What would you infer about how series and parallel circuits work from your observations?  Extend – **Application/Creation**: With the supplies provided, what can you do to make the light bulb brighter or the motor turn faster? What happens when you add more batteries? Why do you think this happened? Work together in your group to see what you need to do to make the light bulb as bright as possible. What happens if you remove a light bulb from its socket when you have 2 or more items connected in series? In parallel? |
| **Closure**  (*The closure provides an opportunity for STUDENTS to demonstrate that they’ve met the learning objectives for the lesson by actively engaging in a short task. Examples of tasks include exit tickets, think-pair-share, use of clickers, etc. The closure can include your summative assessment*.)  Evaluate (10 minutes)  Ask students to complete a 3-2-1 assessment (FACT # 64) in their learning logs.   * Respond to 3 question prompts. * Describe the 2 ways we used to make circuits. Be as specific as possible and include sketches to illustrate. * Write 1 thing that you would like to explore further about circuits that we did not get to do today.   *Note: The interactive notebooks will be collected and reviewed the following day in class.* | Focused on essential ideas of lesson – what are circuits, the different types of circuits and allows an opportunity for students to express what they would like to know or do. |

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| **Adaptations to Meet Individual Needs**  (How will you adapt the instruction to meet the needs of individual students?) |
| High-Level Learners: During the “extend” section these students will be given supplies to create an electromagnet: Wire, bolt, & battery. They will be challenged to use the materials to run electricity through the bolt to make it become magnetic. They will test the magnetism by picking up paper clips. They will be asked to predict and test ways to increase the magnetism using what they know about series and parallel circuits.  On-Level Learners: This lesson plan is structured for on-level learners as written.  Struggling Learners: Ensure that struggling learners are given the opportunity to work with high-level learners that are willing to assist. Provide these students with a word bank and pre-made sketches for part two of the 3-2-1 assessment to allow them an opportunity for success. Also the teacher should ensure time to work one-on-one with these students or within a small group setting. Allow extra time to complete the assessment.  English Language Learner: Same as for struggling learner. Also, provide labels for the tools used such as the light bulb, battery, and switch.  Other individual needs of the students/class you are teaching? *Gardner’s Learning Styles*  Bodily-Kinesthetic: Students are actively constructing circuits with their hands.  Interpersonal: Students will be working in groups to complete the tasks  Intrapersonal: Students will complete their own graphic organizers and 3-2-1 assessments  Logical-Mathematical: Students record findings in their interactive notebooks as they complete the extension portion of the lesson. The data can be used later to make graphs.  Spatial: Students complete sketches in their graphic organizers |
| **Management/Safety Issues**  (*Are there any management and/or safety issues that need to be considered when teaching the lesson? What supports and behavioral management strategies are you providing to your students to facilitate a smooth and structured lesson. Provide classroom-wide strategies as well as those needed for specific students*.) |
| *Content Considerations*  Do not allow any water near the electrical circuitUse caution when using any type of electrical circuit or device because it can get hot.  *Classroom Management Strategies*  The teacher needs to remind the students of standard classroom rules and consequences of respect toward peers, teacher, and materials used in the classroom. The teacher needs to ensure that the students are using their time effectively and efficiently within their groups. Groups need to stay on task in order for the lesson to finish in a timely manner. |
| **Rationale/Theoretical Reasoning** |
| **Rationale**  (*Describe suggestions and research-based best practices for teaching the specific content in your lesson. This should not be generic information that could be applied to any lesson*.)   * Building circuits is a method to help students acquire skills of inquiry at an observational level and an opportunity to systematically test out their ideas and make observations. Many K–8 students are not aware of the bipolarity of batteries and light bulbs. They do not recognize the need for a complete circuit and have difficulty making a bulb light when provided with a battery and wires. Need to provide opportunities to explore batteries, bulbs, and wires, without casings or clips so that they can understand how the current flows through each of the components – this addresses concerns of children only using “electricity kits” without conceptual understanding.   Uncovering Student Ideas in Science: Volume 3, by Page Keeley pg. 59-61 (2008)  **Theory**  (*Include a description of the theory and how it specifically applies to your lesson. Theorists such as Piaget, Vygotsky, Dewey, Gardner, etc*.)   * Researchers have found that students learn science better when they engage in literacy-related activities. p. 8 Academic Language of Science   <http://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=7&cad=rja&ved=0CEUQFjAG&url=http%3A%2F%2Fptgmedia.pearsoncmg.com%2Fimages%2F9780205627592%2Fdownloads%2FSIOP_Sci_Ch.1.pdf&ei=4GuNUPj1B4GCrAHKoYHgBg&usg=AFQjCNF2XcnB37SYclC0SvJIntkddCEehg>   * Provide the most language-heavy instruction of the unit, either verbal or written, AFTER the hands-on investigations.  This will provide a meaningful schema to connect with the new language.   <http://www.classroomscience.org/academic-language-in-science-teaching>   * Students are provided an opportunity to socially construct knowledge while working with their peers. They also have the opportunity to work in their zone of proximal development. (Vygotsky, 1978)   **Common Misconceptions or Difficulties**  (*What are some common areas in which students are likely to have misconceptions or difficulties pertaining to the specific content that you are teaching*?)   * Some students think that if wires are connected to a battery and bulb, no matter where, a complete circuit is made. * Some students will regard one wire as the “active” wire and the second wire as a “safety” wire. * Many students have trouble with batteries/bulbs/wires questions because they have only encountered them when they are part of a kit that includes “housing” for the batteries – with clips – so they are easier to manipulate and set up in a series.   *Uncovering Student Ideas in Science: Volume 3*, by Page Keeley pg. 60-61 (2008) |
| **References**  *(List the sources used in this lesson for activities, vocabulary, rationale, theory, misconceptions, etc.)* |
| ***Some Included with Rationale/Theory above***  Circuit Builder  [http://www.bbc.co.uk/schools/podsmission/electricity/annie03.shtml#](http://www.bbc.co.uk/schools/podsmission/electricity/annie03.shtml)  Vygotsky, L.S. (1978). *Mind in society. The development of higher psychological processes*. Cambridge, MA: Harvard University Press.  Gardner, H. (2000). *Intelligence reframed: Multiple intelligences for the 21st century*. New York: Basic Books  Keeley, P. (2008). *Uncovering Student Ideas in Science: 25 Formative Assessment Probes. Volume 3*. Corwin Press, NSTA Press.  Keeley, P. (2008). *Science Formative Assessment: 75 Practical Strategies for Linking Assessment, Instruction, and Learning.* Corwin Press, NSTA Press  Marcarelli, K. (2010). *Teaching Science with Interactive Notebooks.* Corwin Press |

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| **Reflections/Future Modifications** |
| (*To what extent did the class learn what you intended them to learn? Describe student progress toward mastery of objectives. What trends can you identify*?)  (*How did students use the language function, vocabulary, syntax, and discourse that you identified in the Language Demands section of this lesson plan*?)  (*What will be your next steps instructionally? What goals do you have for immediate and long-term re-teaching and instruction based on feedback you provided to students with varied needs*?)  (*What did you learn about your students as learners? What have you learned about yourself as a teacher*?)  (*Provide principles from research and/or theory specific to the content of your learning segment and students’ needs to support your statements*.) |

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3-2-1 Assessment

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| 3 | Answer these 3 problems …   1. A student tried to connect an electrical circuit as shown below. The lightbulb did not light up. What can the student do to make the lightbulb light up?   2009-4S11+13   1. Connect a second battery to the first battery. 2. Replace the wires with thicker wires. 3. Replace the steel nails with aluminum nails. 4. Connect the steel nails with a short piece of wire.  |  |  | | --- | --- | | 2. | 3. | |
| 2 | Describe the 2 ways we used to make circuits. Be as specific as possible and include sketches to illustrate … |
| 1 | Write 1 thing you would like to explore further about circuits that we did not get to today… |